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Transport Processes in GaN Deposition in a Chemical Vapor Deposition Reactor YOGESH JALURIA, JIANDONG MENG, SUN WONG, Rutgers University — A study has been carried out to characterize the metalorganic chemical vapor deposition (MOCVD) growth of Gallium Nitride (GaN). With trimethylgallium (TMGa) and ammonia (NH_3) carried by hydrogen (H_2), as precursors, the entire process which involves fluid flow, heat and mass transfer and chemical kinetics is modeled. A major objective of this work is to examine the dependence of the growth rate of GaN and film uniformity on the flow, as determined by various design parameters and operating conditions involved in the MOCVD process. The results are expected to provide a quantitative basis for the design and optimization of MOCVD system for the fabrication of GaN devices. The study focuses on techniques to guide the impinging flow, and the effect of buoyancy on the resulting flow. Based on the detailed mathematical model and the appropriate chemical mechanisms, a study on the effects of various critical parameters such as the reactor pressure, inlet velocity, susceptor temperature, inflow concentration and rotating speed on the flow and on the growth rate of GaN and thin-film uniformity is conducted for a 3D rotating reactor. The comparison between 3D modeling and previous 2D impinging vertical reactor modeling is presented. The flow and associated transport processes are discussed, indicating approaches to improve the uniformity of the film. In addition, the dependence of the film quality on the inflow profile is also examined, which makes an attempt to minimize the effect of reactor pressure on fluid loss and reduce flow recirculation.

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